PATENT SPECIFICATION

750,152

Date of filing Complete Specification (under Section 3 (3) of the Patents Act, 1949): March 10, 1954.

Application Date: March 10, 1953. No. 6616/53.

Application Date: July 28, 1953. No. 20951/53.

Complete Specification Published: June 13, 1956.

Index at acceptance:—Classes 81(2), T4B; and 135, V11D, VE5A, VL6C.

COMPLETE SPECIFICATION

An improved Valve for use in Controlling Human Respiration

I, JOHN HENRY BLEASE, of 17, Royston Park Road, Hatch End, Middlesex, a British subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to valves for use in controlling human respiration, which may advantageously be employed with any form of anaesthetic machine or apparatus, or as part of portable resuscitation apparatus. By reason of the simple, efficient and robust construction of the improved valve, as hereinafter set forth, and the fact that it incorporates the minimum of moving parts, it is extremely reliable in operation and is thus particularly applicable to resuscitation apparatus for use by untrained persons in situations of emergency, for example at public baths, bathing stations, the pitheads of mines, in ambulances, and like places where it may suddenly be found necessary to induce respiration by artificial means in a person whose normal breathing has been stopped or inhibited by partial drowning, electric shock or other cause.

The valve of the present invention, with whatever form of apparatus it is employed, is intended to be disposed between a mask applied to the patient's face and the apparatus itself.

The improved valve essentially comprises two members between which a flexible resilient diaphragm is secured, each such member being provided with means whereby an airway therein may be connected to a mask or to anaesthetic or resuscitation apparatus or the like, the flexible diaphragm carrying a valve member whereby air under pressure from the apparatus may pass freely through the valve to the mask, and whereby on cessation of the exertion of pressure by the apparatus, the valve is closed by the relatively small pressure exerted by the lungs of the patient under the influence of atmospheric pressure on the patient's body, and air from the patient's lungs can escape to the exterior without having to overcome the inertia of any moving valve members and with the minimum of resistance to its flow.

The invention may be carried into practice as shown in the accompanying drawing and is hereinafter described with reference to its use as part of a portable resuscitation apparatus, it being understood, however, that it may advantageously be employed as part of any apparatus or machine whereby human respiration is controlled.

In the said drawing,

Figure 1 is a central sectional view of the valve assembly, and

Figures 2 and 3 are sections on the lines II—II and III—III respectively of Figure 1.

As shown in the drawing, a preferred form of the improved valve comprises an assembly formed by two open-ended cylindrical members 1, 2 each having a radial flange at one end thereof, the two flanges 3,4 being provided with screwthreaded means 5 whereby they may be secured together with the interposition of a flexible resilient diaphragm 6, e.g. of rubber. The end of the cylindrical member 1 remote from its flange 3 is connected to a mask by means of flexible rubber tubing in the known manner, and the end of the other cylindrical member 2 remote from its flange 4 is similarly connected by flexible rubber tubing to a means for supplying air or oxygen to the patient, e.g. a hand-operated bellows or pump, and oxygen cylinder, etc.

The radial flange 3 provided upon the cylindrical member 1 adapted to be connected to the mask has an annular recess 7 provided in the face thereof directed towards the other flange, so as to provide a hermetic seal with the flexible diaphragm adjacent the outer periphery of the flanges, and an inner seating 8 against which the diaphragm 6 may be pressed when flexed by pressure building up on the remote side thereof. In the unflexed state of the diaphragm 6, an air chamber is thus provided between the diaphragm and the inwardly directed face of the

[Pr.

recessed flange 3. The flange 3 provided upon the cylindrical member 1 connected to the mask has a number of apertures 9 pierced therethrough in communication with the annular recess above referred to.

Mounted centrally upon the flexible diaphragm 6, is a valve formed by a metal disc 10 and annulus 11 secured together at their peripheries so as to enclose the diaphragm 6 and form a hermetic seal therewith; apertures 12 are formed in the disc 10, and the part of the diaphragm between the disc 10 and the annulus 11 is cut away to provide an air passage through such apertures. Mounted on the side of the valve formed by the disc 10 and annulus 11 nearest to the mask is a second flexible resilient diaphragm of rubber 13, secured at its centre to the discs, for example by means of a screw-threaded pin 14 passing through the disc, and a nut 15 holding the said second flexible diaphragm 13 on such pin in contact with the apertured disc 10. A cushioning washer 16 is provided in a recess in the flange 4, against which the annulus 11 abuts when the diaphragm 6 is flexed in a direction away from the mask, i.e. during exhalation by the patient.

The said second flexible diaphragm 13 is in the form of a disc made of sheet rubber of such a thickness, flexibility and resiliency as to be readily flexed to permit passage of air or oxygen from the bellows or oxygen cylinder through the valve in one direction, and to return to its normal unflexed position to occlude the passageways 12 through the apertured discs 10,11 when air is being exhaled by the patient, without interposing any impediment to the outwards passage of air during such exhalation.

The operation of the improved valve is as follows:—

Air or oxygen is introduced into the cylindrical member 2 having the unapertured radial flange 4 thereon, causing the centrally disposed flexible diaphragm 6 to be flexed away from the air inlet, thus pressing the diaphragm against the seating 8 formed on the inner face of the annularly recessed and apertured flange 3, and preventing outwards passage of air through the apertures 9 in said flange, and at the same time opening the valve member centrally disposed on the said flexible diaphragm by flexing the second flexible diaphragm 13 away from its normal position occluding the apertures 12 in the disc 10 forming the said valve member. Air or oxygen passing through the apertures 12 thus passes to the mask, the air exit through the apertures 9 in the radial flange of the cylindrical member 1 being closed as above set forth.

On cessation of the pumping stroke of the bellows, or closure of the outlet valve of the oxygen cylinder, the pressure drops on the side of the first or main diaphragm 6 opposite to the inlet, and the natural resilience of this diaphragm at once returns it to its normal unflexed position, thus moving it out of contact with the seating 8 formed on the annularly recessed face of the radial flange 3 nearer to the mask, and opening an air exit from the mask to the atmosphere through the apertures 9. At the same time, the natural resiliency of the second diaphragm 13 similarly returns it to its normal unflexed position, and air is expelled from the patient's lungs through the mask, thereby occluding passage of air through the apertures 12 in the metal disc 10 supported in the centre of the first flexible diaphragm 6. The cycle is then repeated.

In a modified constructional form of valve, the apertured disc 10, the annulus 11 and diaphragm 13 are replaced by a valve casing consisting of a hollow cylinder, one end and the cylindrical wall of which are apertured, such apertured part of the casing lying on the same side of the diaphragm 6 as the connection to the mask. The other end of the cylindrical valve casing, which lies on the same side of the diaphragm 6 as the connection to the bellows or oxygen cylinder, is closed by a disc valve member urged to its closing position on a seating in the valve casing by a spring acting between such disc and the apertured end wall of the casing. The valve casing is guided in its axial travel during flexure of the resilient diaphragm upon which it is mounted by a rod or the like extending axially from the apertured end wall of the casing, the free end of such rod passing through a guide hole provided in a fixed bridge member extending across the interior of the cylindrical member leading to the mask.

The operation of this valve means is as follows:—

Air or oxygen is introduced into the cylindrical member 2 having the unapertured radial flange thereon, causing the centrally disposed flexible diaphragm 6 to be flexed away from the air inlet to lie against the valve seating 8 formed on the innerface of the annularly recessed and apertured flange 3, at the same time moving the disc valve member off its seating against the effort of its spring, and thus opening a passageway through the valve assembly for air or oxygen to the flexible tubing leading to the mask.

On cessation of the pumping stroke of the bellows, or closure of the outlet valve of the oxygen cylinder, the pressure drops on the side of the diaphragm opposite to the air inlet, and the natural resiliency of the flexible diaphragm 6 at once returns it to its normal unflexed position, thus moving it out of contact with the seating 8 formed on the annularly recessed face of the flange nearer to the mask, and thus opening a passageway for air from the mask to the atmosphere through the

apertures 9 formed in the flange 3. At the same time, the spring acting upon the disc valve supported in the valve casing mounted centrally on the flexible diaphragm 6 returns this disc valve to its seating, so as to close the passageway for air through the diaphragm.

It will readily be appreciated that the design and construction of the improved valve is such that on the cessation of input of air or oxygen into the lungs of the patient, there is an automatic reversal of the possible air passages through the valve, effected by the natural resiliency of the flexible rubber diaphragm returning the same to its normal unflexed position, without it being necessary to employ the pressure exerted by the deflation of the lungs of the patient to overcome the inertia of any moving part of the valve, or to act against any spring, thus approximating very closely to the ideal in which there would be no resistance whatsoever to the passage of air outwardly from the lungs of the patient.

What I claim is:—

1. Valve means for controlling human respiration, comprising two members between which a flexible resilient diaphragm is secured, each such member being provided with a connection to an air way leading to a mask or to anaesthetic or resuscitation apparatus or the like, the flexible diaphragm carrying a valve member whereby air under pressure from the apparatus may pass freely through the valve to the mask, and whereby on cessation of exertion of pressure by such apparatus the valve is automatically closed to permit passage of air from the lungs of the patient to atmosphere without having to overcome the inertia of any valve member and with the minimum of resistance to its flow.

2. Valve means according to Claim 1, wherein the member having a connection to an airway to the mask is provided with a number of apertures to atmosphere, such apertures being obturated by flexure of the flexible diaphragm during the exertion of pressure by the apparatus, and being opened by return flexure of the diaphragm on cessation of exertion of such pressure to permit unrestricted outflow of the contents of the patient's lungs.

3. Valve means according to Claims 1 or 2, comprising two open-ended cylindrical members having radial flanges between which the flexible diaphragm is secured, the member connected to the mask having an annular recess formed in the inner face of its flange adjacent its periphery, a series of apertures in the wall of the flange within such recess, and an annular seating for the flexible diaphragm adjacent such recess.

4. Valve means according to any of the preceding claims, wherein the valve member carried by the flexible diaphram comprises a rigid disc secured on each side of the diaphragm substantially centrally thereof, airways extending through such discs and through the part of the diaphragm held therebetween, a second resilient and flexible diaphragm secured to the disc on the side of the first-mentioned diaphragm nearer to the airway to the mask, a peripheral portion of such second diaphragm normally occluding the airways through the discs and opening such airways when flexed by pressure from the side of the first-mentioned diaphragm remote from the airway to the mask, and wherein outlets to atmosphere are provided between the first-mentioned diaphragm and the airway to the mask, such air outlets being occluded by flexure of such diaphragm in a direction towards such airway to the mask.

5. Valve means according to any of Claims 1 to 3, wherein the valve member carried by the flexible diaphragm comprises a hollow cylinder, one end and the cylindrical wall whereof are apertured, such apertured end and apertured cylindrical wall extending from the said diaphragm towards an airway leading to the mask, the other end of the cylindrical valve member being obturated by a disc valve plate urged towards its closed position by a spring, and wherein air outlets to atmosphere are provided between the diaphragm and the airway to the mask such air outlets being occluded by flexure of the diaphragm in a direction towards the airway to the mask.

6. Valve means for controlling human respiration, substantially as hereinabove described, or with reference to the accompanying drawing.

D. YOUNG & CO.,
29, Southampton Buildings, Chancery Lane,
London, W.C.2,
Agents for the Applicant.

PROVISIONAL SPECIFICATION
No. 6616 A.D. 1953

An improved Valve for use in Controlling Human Respiration

I, JOHN HENRY BLEASE, of 17, Royston Park Road, Hatch End, Middlesex, a British subject, do hereby declare this invention to be described in the following statement:—

This invention relates to valves for use in controlling human respiration, which may advantageously be employed with any form of anaesthetic machine or apparatus, or as part of portable resuscitation apparatus. By reason of its simplicity, as hereinafter set forth, it is

particularly applicable to portable resuscitation apparatus for use in such situations as public baths, bathing stations, the pitheads of mines, in ambulances, at hospitals, and the like, where it is required to give artificial respiration to a person whose breathing has been stopped by partial drowning, electrical shock or other cause.

The value of the present invention, with whatever form of apparatus is employed, is disposed between the mask applied to the patient's face and the next nearest part of such apparatus.

The invention will hereinafter be described with respect to its use as part of a portable resuscitation apparatus, it being understood, however, that it may advantageously be employed as part of any apparatus or machine whereby the human respiration is controlled.

In one constructional form of the improved valve, the said valve comprises an assembly formed by two open-ended cylindrical members each having a radial flange at one end thereof, the two flanges being provided with means whereby they may be secured together with the interposition of a flexible resilient diaphragm, e.g. of rubber. The end of one of the cylindrical members remote from its flange is connected by means of flexible tubing in the known manner to the mask and the end of the other cylindrical member remote from its flange is connected by flexible tubing in the known manner to the means for supplying air or oxygen to the patient.

The radial flange provided upon the cylindrical member adapted to be connected to the mask has an annular recess provided in the face thereof directed towards the other flange, so as to provide a hermetic seal with the flexible diaphragm adjacent the outer periphery of the flanges, and an inner seating against which the diaphragm may be pressed when flexed by pressure building up on the remote side thereof. In the unflexed state of the diaphragm, an air chamber is thus provided between the diaphragm and the inwardly directed face of the recessed flange.

Mounted centrally upon the flexible diaphragm is a valve casing consisting of a hollow cylinder, one end and the cylindrical wall of which are apertured, such apertured part of the casing lying on the same side of the diaphragm as the connection to the mask. The other end of the cylindrical valve casing, which lies on the same side of the diaphragm as the connection to the bellows or oxygen cylinder, is closed by a disc valve member urged to its closing position on a seating in the valve casing by a spring acting between such disc and the apertured end wall of the casing. The valve casing is guided in its axial travel during flexure of the resilient diaphragm upon which it is mounted by a rod or the like extending axially from the apertured end wall of the casing, the free end of such rod passing through a guide hole provided in a fixed bridge member extending across the interior of the cylindrical member leading to the mask.

The flange formed on the cylindrical member connected to the mask has a number of apertures pierced therethrough, such apertures extending into the annular recess formed in the inner face of the flange between its outer periphery and the inner valve seating formed thereon.

The operation of this valve means is as follows:—

Air or oxygen is introduced into the cylindrical member having the unapertured radial flange thereon, causing the centrally disposed flexible diaphragm to be flexed away from the air inlet to lie against the valve seating formed on the inner face of the annularly recessed and apertured flange, at the same time moving the disc valve member off its seating against the effort of its spring, and thus opening a passageway through the valve assembly for air or oxygen to the flexible tubing leading to the mask.

On cessation of the pumping stroke of the bellows, or closure of the outlet valve of the oxygen cylinder, the pressure drops on the side of the diaphragm opposite to the air inlet, and the natural resiliency of the flexible diaphragm at once returns to its normal unflexed position, thus moving it out of contact with the seating formed on the annularly recessed face of the flange nearer to the mask, and thus opening a passageway for air from the mask to the atmosphere through the apertures formed in the flange in communication with the annular recess therein. At the same time, the spring acting upon the disc valve supported in the valve casing mounted centrally on the flexible diaphragm returns this disc valve to its seating, so as to close the passageway for air through the diaphragm.

As will readily be seen, this cycle of operation is continuously repeated automatically by the intermittent opening and closing of the outlet valve of the oxygen cylinder, where such form of supply is employed, or by the regularly spaced strokes of a bellows or air pump, where it is not desired to employ oxygen under pressure. The effort to be exerted by the lungs of the patient in exhalation, when the introduction of air or oxygen or air under pressure ceases, is reduced to a minimum, the natural resiliency of the flexible diaphragm at once returning it to its unflexed position between the two flanges when pressure is no longer applied to the side thereof remote from the mask, and the free passage of air from the lungs of the patient to atmosphere through the apertures in the annularly recessed flange being immediately possible.

D. YOUNG & CO.,
29, Southampton Buildings, Chancery Lane,
London, W.C.2,
Agents for the Applicant.

PROVISIONAL SPECIFICATION
No. 20951 A.D. 1953

An improved Valve for use in Controlling Human Respiration

I, JOHN HENRY BLEASE, of 17, Royston Park Road, Hatch End, Middlesex, a British subject, do hereby declare this invention to be described in the following statement: —

This invention relates to valves for use in controlling human respiration, which may advantageously be employed with any form of anaesthetic machine or apparatus, or as part of portable resuscitation apparatus. By reason of the simple, efficient and robust construction of the improved valve, as hereinafter set forth, and the fact that it incorporates the minimum of moving parts, it is extremely reliable in operation, and is thus particularly applicable to resuscitation apparatus for use by untrained persons in situations of emergency, for example at public baths, bathing stations, the pitheads of mines, in ambulances, and like places where it may suddenly be found necessary to induce respiration by artificial means in a person whose normal breathing has been stopped or inhibited by partial drowning, electric shock or other cause.

The valve of the present invention, with whatever form of apparatus it is employed, is intended to be disposed between a mask applied to the patients face and the apparatus itself.

The improved valve essentially comprises two members between which a flexible resilient diaphragm is secured, each such member being provided with means whereby an airway therein may be connected to a mask or to anaesthetic or resuscitation apparatus or the like, the flexible diaphragm carrying a valve member whereby air under pressure from the apparatus may pass freely through the valve to the mask, and whereby on cessation of the exertion of pressure by the apparatus, the valve is closed by the relatively small pressure exerted by the lungs of the patient under the influence of atmospheric pressure on the patient's body, and air from the patient's lungs can escape to the exterior without having to overcome the inertia of any moving valve members and with the minimum of resistance to its flow.

The invention may be carried into practice in the following manner, hereinafter described with reference to its use as part of a portable resuscitation apparatus, it being understood, however, that it may advantageously be employed as part of any apparatus or machine whereby human respiration is controlled.

In a preferred constructional form of the improved valve, the said valve comprises an assembly formed by two open-ended cylindrical members each having a radial flange at one end thereof, the two flanges being provided with means whereby they may be secured together with the interposition of a flexible resilient diaphragm, e.g. of rubber. The end of one of these cylindrical members remote from its flange is connected to a mask by means of flexible rubber tubing in the known manner, and the end of the other cylindrical member remote from its flange is similarly connected by flexible rubber tubing to a means for supplying air or oxygen to the patient, e.g. a hand-operated bellows or pump, an oxygen cylinder, etc.

The radial flange provided upon the cylindrical member adapted to be connected to the mask has an annular recess provided in the face thereof directed towards the other flange, so as to provide a hermetic seal with the flexible diaphragm adjacent the outer periphery of the flanges, and an inner seating or seatings against which the diaphragm may be pressed when flexed by pressure building up on the remote side thereof. In the unflexed state of the diaphragm, an air chamber is thus provided between the diaphragm and the inwardly directed face of the recessed flange. The flange provided upon the cylindrical member connected to the mask has a number of apertures pierced therethrough in communication with the annular recess above referred to.

Mounted centrally upon the flexibly diaphragm, is a valve formed by two metal discs secured together at their peripheries so as to enclose the diaphragm and form a hermetic seal therewith; registering apertures are formed in these two discs on a circle intermediate of the peripheries and the centres thereof, and the part of the diaphragm between the discs is cut away to provide an air passage through such registering apertures. Mounted on the side of the valve formed by these two discs nearest to the mask is a second flexible resilient diaphragm of rubber, secured at its centre to the discs, for example by means of a screwthreaded pin passing through the

discs, and a nut holding the said second flexible diaphragm on such pin in contact with the apertured disc.

The said second flexible diaphragm is in the form of a disc made of sheet rubber of such a thickness, flexibility and resiliency as to be readily flexed to permit passage of air or oxygen from the bellows or oxygen cylinder through the valve in one direction, and to return to its normal unflexed position to occlude the passageways for air through the apertured discs when air is being exhaled by the patient under the influence of gravity, without interposing any impediment to the outwards passage of air during such exhalation.

The operation of the improved valve is as follows:—

Air or oxygen is introduced into the cylindrical member having the unapertured radial flange thereon, causing the centrally disposed flexible diaphragm held between the two flanges to be flexed away from the air inlet, thus pressing the diaphragm against the seatings formed on the inner face of the annularly recessed and apertured flange, and preventing outwards passage of air through the apertures in said flange, and at the same time opening the valve member centrally disposed on the said flexible diaphragm by flexing the second flexible diaphragm away from its normal position occluding the registering apertures in the discs forming the said valve member. Air or oxygen passing through the registering apertures in the discs thus passes to the mask, the air exit through the apertures in the radial flange of the cylindrical member connected to the mask being closed as above set forth.

On cessation of the pumping stroke of the bellows, or closure of the outlet valve of the oxygen cylinder, the pressure drops on the side of the first or main diaphragm opposite to the inlet, and the natural resilience of this diaphragm at once returns it to its normal unflexed position, thus moving it out of contact with the seatings formed on the annularly recessed face of the radial flange nearer to the mask, and opening an air exit from the mask to the atmosphere. At the same time, the natural resiliency of the second diaphragm similarly returns it to its normal unflexed position aided if necessary by the pressure exerted by gravity upon the body of the patient to expel air from the patient's lungs through the mask, thereby occluding passage of air through the registering apertures in the two metal discs supported in the centre of the first flexible diaphragm. The cycle is then repeated.

It will readily be appreciated that the design and construction of the improved valve is such that on the cessation of input of air or oxygen into the lungs of the patient, there is an automatic reversal of the possible air passages through the valve, effected by the natural resiliency of two flexible rubber diaphragms returning the same to their normal unflexed positions, without it being necessary to employ the pressure exerted by the deflation of the lungs of the patient to overcome the inertia of any moving part of the valve, or act against any spring, thus approximating very closely to the ideal in which there would be no resistance whatsoever to the passage of air outwardly from the lungs of the patient.

D. YOUNG & CO.,
29, Southampton Buildings, Chancery Lane,
London, W.C.2,
Agents for the Applicant.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1956.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

750,152 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

Fig. 1.

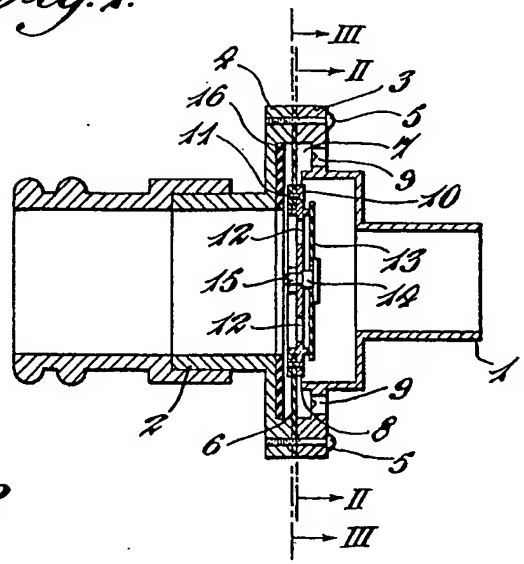

Fig. 2.

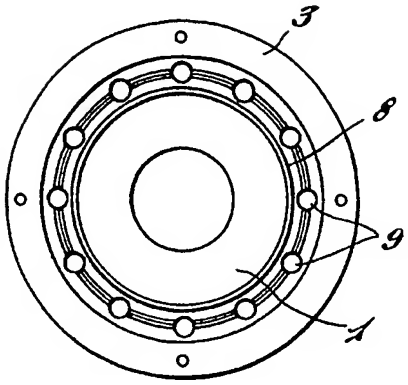

Fig. 3.